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NPIC/TSSG/DED-1712-69  
8 July 1969

MEMORANDUM FOR THE RECORD

SUBJECT : Duplication Study and Optimal Image Evaluation Programs at AFSPFF

25X1 1. The third bi-monthly contract review of the SPFF Duplication Study and Optimal Image Evaluation (Information/Technology) contracts was held on 12-13 June respectively at SPFF. I attended as the NPIC observer. This memorandum summarizes the substance of each meeting.

25X1 2. Summary of the Duplication Study Review

a. [ ] presented an oral report on the status of this one year program begun in December 1968. The contract objective is to determine objective measures of dupe positive quality and their relationship to the subjective evaluation of information, as judged by the PI. A program statement of work is attached as enclosure 1.

25X1 25X1 25X1 b. The preparations for the subjective testing phase of the program are underway. An experimental technique similar to that used on Project [ ] will be employed though the images will be of the [ ] model target, not [ ] imagery. It was pointed out that the questions proposed dealt mainly with mensuration tasks and this would limit the applicability of results. [ ] agreed to develop questions in other areas. The interpreters to be used as subjects are employed by [ ] There are no plans to involve NPIC PI's at this time. The data collection technique consists of furnishing a PI with EEI, photographs selected as typical (from a target point of view) but with built in variations in quality (grain, definition, contrast etc.), and a list of questions to be answered. The degree to which the PI answers the questions or satisfies the EEI, will be taken as a measure of the information content of the photograph. No attempt will be made to solicit an opinion from the PI as to the characteristics he feels a good quality photograph should possess. The subjective responses collected will be examined statistically for correlation with the known objective parameters.

c. The experimental approach just described has been employed in the past by other investigators (e.g., [ ] without conclusive results. In order to improve chances for success in the present effort, considerable attention will be paid to: (1) developing levels of difference in the objective parameters which are sensitive to PI response, (2) making the experimental procedure typical of the particular duplication system employed.

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d. The objective areas to be investigated in a multiparameter analysis are: (1) scale, (2) resolution, (3) target, (4) dupe policy, (5) acquisition parameters, (6) processing, (7) noise.

e. The response variables will be selected from within these areas; not all will be varied. NOTE: the present standard (single gamma) processing of the dupe and O-N materials will be employed. No tests with viscous processing are included.

f. At present experiments are underway within  to determine the specific objective variables to be employed.

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(1) Granulairty and Wiener spectrum (noise) analysis has received considerable attention to date.  has found micro-densitometer focus, variations in film thickness, and the matte or pelloid presence to be experimental problem areas. A focus series is essential; granularity and Wiener spectrum measurements are both sensitive to the presence of the matte. The granulairty value w/o matte is about 1/2 that with matte; the Wiener spectrum has unwanted peaks with matte, they disappear when it is removed.

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(2) Experiments are also being conducted to determine the effect of cascading grain (3404 - 2430) and the mechanism of light diffusion within the emulsion. A pseudo MTF to describe the effects is being considered.

(3) The visual edge matching resolving power tests, originally considered, have proven unsatisfactory; they have been deleted from the program.

g. Although not specified in the work statement, some experiments involving dual gamma have been conducted to gain experience. Edges produced in conjunction with another contract and processed in dual gamma chemistry, were measured on a microdensitometer. A series of traces is attached as enclosure 2. The exposure was held constant while the edge contrast was varied. The traces indicate the presence of boundary distortions at each contrast, even 2.2:1.

(1)  found contrast of dual gamma processed, line and bar images, higher than predicted by exposure considerations. (Density is converted to effective diffuse (ASA) values). This would be expected for the boundary values, but not for the areas toward the center of the image. It may well be that the traces were not continued far enough and/or that the boundary distortions occur over a larger area than had been thought. An experiment to find out will be conducted.

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25X1 (2) No exposure variations were included in the experiment.  
[ ] doesn't plan to do so in the present program due to time.  
SPPF may do these experiments on their own.

(3) The determination of the effect of the boundary distortions on the dupe positive was recognized as an experiment crying to be done; however, it is not part of the present program.

(4) From the viscous processing experiments performed to date, the possibility of boundary distortions in 2430, when so processed, is high; however, SPFF has no plans for immediate experiments.

h. The results of the duplication study program will hopefully provide SPFF with specific criteria on which to build a "dupe policy" or a series of "dupe policies" if necessary. SPFF uses the term "policy" as we use specification.

25X1 3. Discussion - Duplication Study [ ]

a. The results of this program may not apply directly to NPIC because no NPIC PI's will be used and because the processing conditions do not include dual gamma. For these reasons and others, the [ ] effort does not obviate the duplication study under consideration within NPIC. The NPIC experiments being considered attack the essential question, i.e., what does the PI think he wants in an image? The answer to this question should provide a basis for all specifications subsequently established. If the NPIC program is successful it will provide a proven experimental technique.

b. It would be of value to compare NPIC traces of edges with boundary distortions to those produced by [ ] Perhaps the exposure variations experiments could be performed also.

c. The extensive effort devoted to the noise parameters of each step of the system has promise and should be followed closely. [ ] is developing software which may be of use to NPIC for similar studies.

d. The comments on the possible effects of viscous processing on the dupe-positive justify experiments on this topic. A PAR may appropriate.

25X1 4. Summary of the Optimal Image Evaluation Contract Review

a. This program is under contract to [ ]  
[ ] are the principal investigators; during the review each presented a summary of his efforts to date. A copy of the third bi-monthly [ ] letter report is attached as enclosure 3. This report includes an agenda, and a list of reports (with computer programs) submitted to SPFF. The work is performed as a task under a T&M contract.

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25X1 b. [ ] discussed the work done toward developing duplicate reproduction policies based on varying characteristics in the original negative processed in "single gamma" chemistry. A copy of his report on this subject is attached as enclosure 4. The techniques employed may be of value to NPIC in pursuing similar goals with O-N processed in dual gamma chemistry. The specific results, however, apply only to the SPFF process. One result that should be noted is that the grain transfer and not mechanical printer problems is the primary cause of resolution loss in the duplication stage.

c. While addressing the future of dupe processing, [ ] discussed preliminary evidence concerning the effects of the viscous processing on 2430 (gathered as part of another experiment) which indicates that boundary distortions are present due to this chemistry also. The manner in which these will interact with those present in an O-N has yet to be determined. 25X1

d. In a comparison of edges processed in single gamma chemistry (O-N vs. dupe), microdensitometer measurements indicate the dupe edge is the sharper of the two. This, perhaps curious result, argues that definition may improve through duplication. Further experiments will be performed in this area. Finally, [ ] indicated that the tone-reproduction analysis worked well for the single gamma processed imagery. Experiments on dual gamma imagery should be performed. 25X1

e. [ ] discussed non-linear analysis techniques being investigated to treat film processed in dual gamma chemistry. His approach employs lines and edges; of course, the resultant parameter will apply only to SPFF; however, the technique developed will be of value to NPIC. A comprehensive non-linear analysis provides: (1) A pseudo transfer function sensitive to the system concerned; (2) An explicit input/output relation; (3) a tool for fault or defect isolation. The theory has been developed, Mr. [ ] will now concern himself with the application. 25X1 25X1

f. [ ] reviewed his system analysis approach to diagnostics. The objective is to develop more meaningful tools and better measures of O-N quality for use in the PET. He requires acquisition system data before he can perform any experiments (SPFF is arranging for this). He will examine the relationship between resolution, contrast, and exposure as affected by IMC and other defects. The result of these efforts will be a system model that can be examined to predict the effects of changes on the O-N or to determine probable cause of troubles experienced.

g. Under this same contract [ ] is investigating a new type of target; i.e., a single line. The target is placed with the other [ ] targets at selected locations. Data analysis has just begun. Indications are that this type of impulse input may be sensitive to system non-linearities where the traditional bars are not. This experiment should be followed closely--it may provide a good quality parameter for use in a multiparameter analysis. 25X1 25X1

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5. Discussion - Info/Tech Presentation

a. The primary effort at this time is devoted to single gamma processed O-N; the non-linear analysis is just getting underway. Close liaison will provide valuable assistance in designing experiments within NPIC. The non-linear techniques may be directly applicable.

b. Since NPIC will be the principal recipient of dupe positive processed in viscous chemistry it would be appropriate to examine samples of this product ahead of time to gain insight into [ ] hypothesis concerning the presence of boundary distortions.

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6. General Comments

a. The next review meeting will be held o/a 11 August. The procedure under investigation now should be refined by that time.

b. In the long run, SPPF will have a well defined set of procedures to guide the O-N and dupe positive processing and reproduction. Since their initial results will not apply to dual gamma chemistry, a psychophysical experiment within NPIC is necessary to establish optimum dupe parameters for internal application. The results of such an experiment would meet immediate needs and provide a basis for development of objective correlates in the future.

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Attachments: a/s

Distribution:

Original - Route & File  
3 - TSSG/DED  
1 - PPBS  
1 - C/AFSD  
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NPIC/TSSG/DED [ ]

(9 July 1969)